

## SEQUENCE LISTING

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&lt;170&gt; PatentIn version 3.1

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 Pro Gly Pro Val Gly Pro Ser Gly Lys Asp Gly Ser Asn Gly Met  
 1100 1105 1110  
 Pro Gly Pro Ile Gly Pro Pro Gly Pro Arg Gly Arg Ser Gly Glu  
 1115 1120 1125  
 Pro Gly Pro Ala Gly Pro Pro Gly Asn Pro Gly Pro Pro Gly Pro  
 1130 1135 1140  
 Pro Gly Pro Pro Gly Thr Gly Ile Asp Met Ser Ala Phe Ala Gly  
 1145 1150 1155  
 Leu Gly Gln Thr Glu Lys Gly Pro Asp Pro Ile Arg Tyr Met Arg  
 1160 1165 1170  
 Ala Asp Glu Ala Ala Gly Gly Leu Arg Gln His Asp Val Glu Val  
 1175 1180 1185

Asp Ala Thr Leu Lys Ser Leu Asn Asn Gln Ile Glu Ser Ile Arg  
 1190 1195 1200  
 Ser Pro Glu Gly Ser Lys Lys Asn Pro Ala Arg Thr Cys Arg Asp  
 1205 1210 1215  
 Ile Lys Leu Cys His Pro Glu Trp Lys Ser Gly Asp Tyr Trp Ile  
 1220 1225 1230  
 Asp Pro Asn Gln Gly Cys Thr Leu Asp Ala Ile Lys Val Phe Cys  
 1235 1240 1245  
 Asn Met Glu Thr Gly Glu Thr Cys Val Tyr Pro Thr Pro Ser Ser  
 1250 1255 1260  
 Ile Pro Arg Lys Asn Trp Trp Thr Ser Lys Thr Lys Asp Lys Lys  
 1265 1270 1275  
 His Val Trp Phe Ala Glu Thr Ile Asn Gly Gly Phe His Phe Ser  
 1280 1285 1290  
 Tyr Gly Asp Glu Asn Leu Ser Pro Asn Thr Ala Ser Ile Gln Met  
 1295 1300 1305  
 Thr Phe Leu Arg Leu Leu Ser Thr Glu Gly Ser Gln Asn Val Thr  
 1310 1315 1320  
 Tyr His Cys Lys Asn Ser Ile Ala Tyr Met Asp Glu Glu Thr Gly  
 1325 1330 1335  
 Asn Leu Lys Lys Ala Ile Leu Ile Gln Gly Ser Asn Asp Val Glu  
 1340 1345 1350  
 Ile Arg Ala Glu Gly Asn Ser Arg Phe Thr Tyr Ser Val Leu Glu  
 1355 1360 1365  
 Asp Gly Cys Thr Lys His Thr Gly Lys Trp Gly Lys Thr Val Ile  
 1370 1375 1380  
 Glu Tyr Arg Leu Gln Lys Thr Ser Arg Leu Ser Ile Val Asp Thr  
 1385 1390 1395  
 Ala Pro Met Asp Ile Gly Gly Ala Asp Gln Glu Phe Gly Val Asp  
 1400 1405 1410  
 Ile Gly Pro Val Cys Phe Leu  
 1415 1420

## References

1. Jenkins JK, Hardy KJ. Biological modifier therapy for the treatment of rheumatoid arthritis. *Am J Med Sci*, 2002,323(4):197-205.
2. Danos O, Malligan MC. Safe and efficient generation of recombinant retrovirus with amphotropic host ranges. *Proc Natl Acad Sci USA*, 1988,85:6460-6465.
3. Roessler BJ, Allen ED, Wilson JM. Adenoviral-mediated gene transfer to rabbit synovium in vivo. *J Clin Invest*, 1993,92:1085-1092.
4. Trentham DE, Dynesius-Trentham RA, Orav EJ, et al. Effects of oral administration of type II collagen on rheumatoid arthritis. *Science*, 1993,261: 1727-1730,
5. Sandell LJ, Prentice HL, Kravis D, Upholt WB. Structure and sequence of the chicken type II procollagen gene. *J Biol Chem*, 1984,259 (12) 7826-7834.
6. Horton RM, Hunt HD, Ho SN, et al. Engineering hybrid genes without the use of restriction enzymes: gene splicing by overlap extension. *Gene*, 1989, 77:61-68.
7. Sambrook J, Fritsch EF, Maniatis T. Molecular cloning: a laboratory manual. 2<sup>nd</sup> ed Cold Spring Harbor Laboratory Press, 1989.
8. Nah DH, Upholt WB. Type II collagen mRNA containing an alternatively spliced exon predominates in the chick limb prior to chondrogenesis. *J Biol Chem*, 1991, 266 34:23446-23452.
9. Rousseau JC, Farjanel J, Boutillon MM, et al. Processing of type XI collagen. Determination of the matrix forms of the alpha 1 (XI) chain. *J Biol Chem*, 1996,271(39): 23743-8.
10. Snellman A, Keranen MR, Hagg PO, et al. Type XIII collagen forms homotrimers with three triple helical collagenous domains and its association into disulfide-bonded trimers is enhanced by proly 4-hydroxylase. *J Biol Chem*, 2000, 275(12):8936-44.
11. Young MF, Vogeli G, Nunez AM, et al. Isolation of cDNA and genomic DNA clones encoding type II collagen. *Nucleic Acids Res*, 1984,12 (10): 4207-4228.
12. Marshall GE, Konstas AGP, Lee WR. Collagens in ocular tissues. *BrJ Ophthalmol*, 1993,77:515-524.

13. Seery CM, Davison PF. Collagen of the bovine vitreous. *Invest Ophthalmol Vis Sci*, 1991, 32:1540-1550.
14. Huerre-Jeanpierre C, Mattei MG, Weil D, et al. Further evidence for the dispersion of the human fibrillar collagen genes. *Am J Hum Genet*, 1986, 38(1): 26-37.
15. Ausar SF, Beltramo DM, Castagna LF, et al. Treatment of rheumatoid arthritis by oral tolerance of bovine tracheal type II collagen. *Rheumatol Int*, 2001, 20:138-144.
16. Barnett ML, Combitchi D, Trentham DE. A pilot trial of oral type II collagen in the treatment of juvenile rheumatoid arthritis. *Arthritis & Rheumatism*, 1996, 39 4:623-628.
17. Kim WU, Lee WK, Ryoo JW, et al. Suppression of collagen-induced arthritis by single administration of poly(lactic-co-glycolic acid) nanoparticles entrapping type II collagen: a novel treatment strategy for induction of oral tolerance. *Arthritis Rheum*, 2002, 46:1109-20.